



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION 5  
77 WEST JACKSON BOULEVARD  
CHICAGO, IL 60604-3590

**To:** Well file, MI-125-2R-0003

**From:** Anna Miller, UIC Branch

**Re:** USDW and Confining Zone; Proposed UIC Well- Permit Application  
MI-125-2R-0003, Lanphar 1-12, Oakland County, Michigan

**Location:** Section 12, T5N, R11E, NW ¼, SW ¼, SE ¼

**Date:** October 7, 2016

Information contributing to the determination of the USDW, confining zone and injection zone:

- Michigan Hydrogeologic Atlas, Part I: Hydrology for Underground injection Control in Michigan, and Part II (maps and tables) (Department of Geology, Western Michigan University, Kalamazoo, Michigan, 1981);
- Stratigraphic Nomenclature for Michigan, Michigan Department of Environmental Quality, 2000 (Michigan stratigraphic column);
- Summary of Hydrogeologic Conditions by County for the State of Michigan—U.S. Geological Survey Open-File Report 2007-1236, 87 pp. Date Posted: September 21, 2007 (Apple, Beth A. and Howard W. Reeves)
- The application from Energex Petroleum Inc., including submitted well logs for Lanphar #1-12).

USDW:

The lowermost USDW at the Lanphar #1-12 well site is the Glacial Drift, with its base depth at 362' below ground surface. The Marshall Sandstone is absent at the well site, as confirmed by well logs for Lanphar #1-12.

Confining Zone:

The confining zone is stratigraphically above and adjacent to the injection zone. The confining zone at the well site is comprised of the lowermost formations of the Salina Group at the site — the A-1 Carbonate (also known as the Ruff Formation), A-2 Evaporate, and A-2 Carbonate. The Michigan Hydrogeologic Atlas notes that where the A-1 Carbonate (Ruff Formation) is salt-plugged, it is an excellent confining layer. The Lanphar 1-12 describes the formation as salt-plugged in this horizon. The Atlas also notes that the A-2 Evaporite and the A-2 Carbonate are excellent confining layers. In the Lanphar 1-12 wells, these formations are present between, 3762' and 3988' bgs. Therefore, the confining zone is 226 feet thick. In addition, the stratigraphy at the well site includes other known aquitard/aquiclude layers above the confining

zone that can impede upward flow (e.g., the Salina Group's B Unit and the C Unit Formations layers of essentially impermeable salt and shale respectively).

The original application includes some conflicting tables about the depth to the confining zone, in particular the top of the A-2 Carbonate. EPA used the applicant's narrative on Attachment G, page 6 of the Letter providing supplemental information for the application, received 11/25/16 was used for evaluating the permit application and site geology, and on well logs filed with MDEQ that were submitted with the application. The applicant also supplied additional information on 6/30/16 to demonstrate that the confining zone is free from fractures in the Area of review.

Injection zone:

The proposed injection zone is the Guelph Formation of the Niagaran Group, between 3988 and 4334 feet, a total thickness of 346 feet. The Guelph formation is a permeable dolomite used as an injection zone in Michigan. The well log shows the general increase of porosity with depth within the Guelph Formation.



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**To:** Well file, MI-125-2R-0003  
**From:** Anna Miller, UIC Branch  
**Re:** Fractures and seismic potential review  
**Date:** 2/21/17

In accordance with 40 CFR § 146.22(a) EPA reviewed site geology to determine that the well is sited in such a fashion that they inject into a formation which is separated from any USDW by a confining zone that is free of known open faults or fractures within the area of review. In addition, EPA reviewed the site for potential seismicity.

**EPA Action**

EPA received an application to permit a Class II UIC well for enhanced recovery for oil and gas production. The Lanphar 1-12 well is an already-constructed well which is proposed to be converted from a production well to an injection well for enhanced oil and gas recovery. EPA's action is to approve or deny a permit based on reviewing the existing construction and proposed operating conditions for suitability as an injection well.

**Evaluation**

EPA considered: materials generated from the U.S. Geological Survey (USGS) online tools; Michigan Hydrogeologic Atlas, Part I: Hydrology for Underground Injection Control in Michigan, Department of Geology, Western Michigan University, Kalamazoo, Michigan, 1981; Stratigraphic Nomenclature for Michigan, Michigan Department of Environmental Quality, 2000; and Stratigraphic Succession in Lower Peninsula of Michigan, Michigan Department of Environmental Quality, 2000. To evaluate the proposed well and operations for potential to induce seismic activity, EPA used the decision model recommended by the UIC National Technical Workgroup in a technical issue paper called "Minimizing and Managing Potential of Injection-Induced Seismicity from Class II Disposal; Practical Approaches" dated February 2, 2015. The decision model was designed to identify the presence of components behind injection-induced seismicity.

Fractures

The Michigan hydrogeologic atlas describes no fractures in the proposed confining zone, the Ruff formation (also known as the Salina A-1 Carbonate). The atlas describes no fractures in additional confining zones above the Ruff formation, including Salina Group A-2 Evaporite and A-2 Carbonate). The atlas' maps of major fractures do not show fractures in the well's ¼-mile area of review. EPA also reviewed geological information from the MDEQ's GeoWebFace database and did not find any major faults or lineaments (potential faults) in the area of review. The applicant also supplied additional information on 6/30/16 to demonstrate that the confining zone is free from fractures in the Area of Review.

### Seismic potential and events

Seismic potential materials from USGS demonstrate that seismic potential in the area is at 0 probability, and the 2014 earthquake hazard map shows potential for seismic hazard is 0-2%. Available records from the USGS dating back to 1973 show that there have been no earthquakes recorded within 100 km (or 63 miles) of the well site.

### Induced Seismicity

For wells that have not injected before, the UIC National Technical Workgroup decision model recommends that EPA evaluate whether there is a history of successful disposal activity in the area; whether there have been area seismic events, and; whether the disposal zone is in or near the basement rock. While the well has not been used previously for injection, another EPA-permitted injection wells within the area of review and within the same township, range, and section have injected at similar depths successfully. In addition, information in the Michigan Hydrogeologic Atlas shows that basement rock is at between 3,000 and 6,000 feet below the injection zone<sup>1</sup>. Finally, EPA looked for evidence of faults and pathways to faults and found none, as stated under the previous section on fractures.

### **Determination**

Based on the above-listed information, EPA found that the confining zone is free of known open faults or fractures in the Area of Review. We also find that the potential for seismicity is 0 in the area surrounding the well, and there have been no earthquakes in the area, so the well is unlikely to be affected by seismicity. The well site is in an area without known large-scale, regional geologic faults or fractures, and is therefore unlikely to allow the transmission of fluids through fractures in the area or in the designated confining zone. We also find that the well is not associated with any of the components that may contribute to induced seismicity.

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<sup>1</sup> Plate 8, Hydrogeologic Atlas of Michigan (atlas maps), Department of Geology, Western Michigan University, Kalamazoo, Michigan, 1981.